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National Aeronautics and  
Space Administration  
Goddard Space Flight Center  
Greenbelt, Maryland 20771

November 9, 1973

ATTENTION: Distribution

RE: Type I Progress Report  
New Jersey Coastal Mapping  
NAS5-21765

Gentlemen:

The New Jersey Department of Environmental Protection and Earth Satellite Corporation are pleased to submit a Type I Progress Report for the two-month period ending October 31, 1973.

A. TITLE: Application of ERTS-1 Data to the Protection and Management of New Jersey's Coastal Environment (SR #304)

B. PRINCIPAL INVESTIGATOR: Mr. Roland S. Yunghans, New Jersey Department of Environmental Protection

C. CO-PRINCIPAL INVESTIGATORS: Dr. Edward B. Feinberg, New Jersey Department of Environmental Protection  
Dr. Frank J. Wobber, Earth Satellite Corporation

N74-11149

Unclassified  
00010D. CO-INVESTIGATOR: Mr. Robert L. Mairs, Earth Satellite Corporation

E. PRINCIPAL CONTRIBUTORS: Mr. Robert T. Macomber, Earth Satellite Corporation  
Mr. Dennis Stanczuk, Earth Satellite Corporation

G3/13

F. OBJECTIVES OF INVESTIGATION:

- to develop useful information products from ERTS-1 analysis of imaged coastal land and marine resources and to apply these products to the regulation, protection, and management of New Jersey's coastal zone.
- to develop a user capability within the New Jersey Department of Environmental Protection to utilize remote sensing data.
- to estimate benefits from ERTS to the New Jersey Department of Environmental Protection.

E74-10010) APPLICATION OF ERTS-1 DATA  
TO THE PROTECTION AND MANAGEMENT OF NEW  
JERSEY'S COASTAL ENVIRONMENT PROGRESS  
Report, period ending 31 Oct. (Earth  
Satellite Corp.) 14 P HC \$3.00 CSCL 08J

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**G. SUMMARY OF ACCOMPLISHMENTS:**

The primary accomplishments during this two-month period of the experiment are summarized on the following pages by phase. Accomplishments are detailed by task in the TASK STATUS REPORT (Appendix A).

**PHASE I: PRE-LAUNCH PREPARATION**

- All pre-launch preparation tasks have been completed except for the letter contacts with other coastal states. A brochure is in the final stages of preparation detailing specific accomplishments realized in New Jersey. A draft letter has been prepared for approval of the Principal Investigator.

**PHASE II: FIRST-LOOK ANALYSIS**

- All first-look analysis tasks have been completed. Many of these tasks are implicitly carried over into Phase III analysis, even though they are not so stated.

**PHASE III: CONTINUING DATA ANALYSIS**

- All ERTS-1 data, collateral aircraft data, and ground truth data are being routinely analyzed for the preparation of information products.
- Problem areas receiving analysis during this reporting period have been centered on ocean outfall placement, offshore waste disposal, coastal zone surveillance (developmental change detection), shore erosion/accretion case study, feasibility of automated data analysis for coastal zone surveillance, and waterfowl/forage crop prediction.
- A preliminary estimate of benefits to the State has been calculated for the four major problem areas; offshore waste disposal, coastal land resources, ocean outfalls, and shore protection. Table 1 is a compilation of this information.
- A working interface has been established between the State's local sewerage authorities, outfall designers and environmental consultants to facilitate the inclusion of ERTS-derived nearshore circulation information into future design of the State's ocean outfalls.

- Preliminary consideration has been given to the feasibility of a computerized change detection analysis of multi-date ERTS tapes to increase timeliness and accuracy over manual analysis and to utilize the maximum resolution capability of the ERTS system.
- Computerized analysis techniques for monitoring offshore waste disposal dumping locations, drift vectors, and dispersion rates have been initiated and several shade prints of disposed wastes have been prepared. A well dispersed dredge spoil dump imaged on 9-27-73 was found to include only four signal intensity levels (on MSS Band 5) between the background water and the most highly reflective area within the dump zone. However, fresh dumps as seen in other orbits are more readily discernible. An increase in the gain setting at the time of data collection would aid analysis of low contrast offshore scenes.
- Accurate discrimination of a well dispersed dump was facilitated on a color additive viewer and on color composite prints by increasing the gamma of ERTS 70mm negatives to a value of between 3 and 4.
- A paper entitled "Remote Sensing of Marine Waste Disposal and Beach Erosion for Coastal Zone Monitoring and Protection" was presented at the Annual Fall Meeting of the American Society of Photogrammetry.
- Rates of erosion and accretion have been calculated from aircraft photography dating back to 1953 along two distinct types of New Jersey shoreline: a developed and a natural beach. These rates are presented in graphic form on an ERTS-1 base map at a scale of 1:250,000. These rates are being used to determine the effectiveness of various shore protection structures in preventing sand removal and encouraging sand accumulation. Information on maintenance and construction expenditures will be used to obtain a cost effectiveness ratio for various shore protection devices. The relationship of erosion rates, property value, and project cost are all criteria for the selection of site type and the extent of a shore protection structure. In addition to the ratio calculations, maximum shoreline recessions within the last 17 years are being determined by computer analysis from measurements made on aerial photographs.
- A continuing dialogue between EarthSat and NJDEP operational users is being maintained.

H. SIGNIFICANT RESULTS:

- A Coastal Zone Surveillance Program has been developed in which systematic comparisons of early ERTS images and recently acquired images are regularly made to identify areas where changes (mainly due to development) have occurred. These changes are reported to NJDEP for field checking in compliance with "New Jersey's Wetlands Act" and their new "Coastal Area Facility Review Act" which call for the monitoring and protection of these areas.
- A methodology for assessing and documenting benefits has been established. The quantification of benefits to date has been directed toward four candidate areas: shore protection, ocean outfalls, coastal land resources, and offshore waste disposal.
- A refinement in the Change Detection Analysis procedure has led to greater accuracy in spotting developmental changes in the Coastal Zone. Comparative analysis of the October 10, 1972 overpass and the July 7, 1973 overpass has shown that over one hundred land development alterations of two acres in extent or greater occurred and were located. The extent of each alteration as interpreted from ERTS was delineated on 1:24,000 scale photo quad sheets. Notification forms are regularly being forwarded to the Division of Marine Services within NJDEP where responsibility for regulation and enforcement of the recently passed Coastal Area Facility Review Act is located.
- Preliminary conclusions drawn from the Shore Erosion case study indicate that in the northern Test Area (developed beach) erosion has occurred more often, is generally more severe, and the beach is slower to recover than in the southern Test Area (natural beach). From these data it appears that it may be possible to define areas most likely to experience further erosion. This is not, strictly speaking, a statistical prediction but rather an assumption that a recognized trend will continue. The assumption of continued erosion in areas that have at one time experienced severe erosion is supported by the simple fact that as a beach narrows wave energy is concentrated on a narrower beach surface. The higher energy condition subsequently results in accelerated erosion. These analyses have direct operational value to NJDEP with respect to where the State allocates yearly funds for shore protection and may impact management decisions for future priorities as to the philosophy of shore protection.

I. PROBLEMS:

Neither NJDEP nor EarthSat have directly received any imagery since the April 7, 1973 overpass (1258-15082). We have been able to

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obtain copies of the imagery through another investigation so analysis has not stopped, but we must have renewed delivery. It was assumed this delay was due to the late approval (August 2, 1973) of the Data Analysis Plan and that delivery would resume shortly thereafter. All imagery is needed by the investigators through the end of the contract period. Our investigation is an attempt to directly implement remote sensing data (ERTS-1) into an operational organization, and in order to respond to operational needs we need timely data.

J. RECOMMENDATIONS FOR TECHNICAL CHANGES:

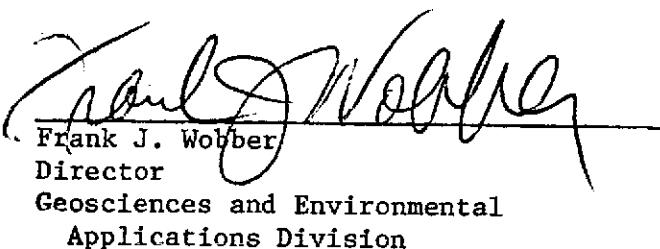
Discussions have been held with the Technical Monitor in an attempt to receive data on a more timely basis to meet operational needs. A request from the Principal Investigator will be forthcoming detailing the need for data approximately 7 days after the day of an overpass for direct implementation into the regulatory aspects of the Coastal Area Facility Review Act. Mr. Robert L. Mairs will, on 1 November 1973, become a co-principal investigator with Dr. Wobber and Dr. Feinberg. Mr. David A. Thibault will become a co-investigator, effective this date.

K. CHANGES TO STANDING ORDER FORMS:

No change is requested; however, receipt of data dating back to April 7, 1973 is again requested.

Sincerely yours,

Original / signed by  
Roland S. Yunghans  
Chief, Office of Environmental Analysis  
New Jersey Department of Environmental  
Protection

  
Frank J. Wobber  
Director  
Geosciences and Environmental  
Applications Division

Attachments

TABLE 1. ERTS-1 CAPABILITIES AND BENEFITS FOR NEW JERSEY

	New Information	Cheaper Information	Manpower Savings	Instrument Savings	Management Information	Time Savings	Analysis Savings	Environment Savings		One-Time Benefits	Yearly Benefits	
<u>WASTE DISPOSAL</u>												
(1) Monitoring	X	X	X	X	X	X	X				50K	
(2) Circulation Analysis	X		X	X	X					200K		Not previously done
(3) Site Recommendations								X			300K	1% recreation increase
<u>COASTAL LAND RESOURCES</u>												
(1) New Legislation		X			X	X	X	X			100K	
(2) Ecozones	X	X	X		X	X	X	X			25K	
(3) Surveillance		X	X	X	X	X	X	X			170K	
<u>OCEAN OUTFALLS</u>												
(1) Placement	X	X	X	X	X	X	X	X		2,500K		
<u>SHORE PROTECTION</u>												
(1) Processes/Analyses		X			X			X			50K	
(2) Funds Allocation	X	X			X		X				25K	With aircraft \$1.0 Million/yr

APPENDIX A

TASK STATUS REPORT  
10/31/73  
Contract NAS5-21765

 = Completed Tasks

TASK	HEADING	STATUS	COMMENTS
PHASE I			
3.1.1	Determine existence of Pre-ERTS imagery for analysis	Completed 10/1/72	Visits were made to NASA MSC (Earth Resources Aircraft Data Bank) at Houston, Texas. A catalog of aircraft imagery has been prepared and delivered to NJDEP for use by state offices.
3.1.2	Assemble ERTS Data Analysis Equipment at NJDEP	Completed 2/1/73	The NJDEP ERTS data analysis facility at the Trenton, New Jersey Headquarters is operational. Basic image analysis equipments are available for ERTS investigators.
3.1.3	Analyze Pre-ERTS imagery set as a demonstration of technique	Completed 10/1/72	ERTS-1, Apollo, and aircraft imagery and their analysis were used to brief NJDEP officials. A manual for reference by state representatives was prepared and distributed.
3.1.4	Organize and conduct preliminary briefing with NJDEP	Completed 10/5/72	Briefing was held at NJDEP to demonstrate remote sensing techniques and possible products to be developed from ERTS. A manual for reference by state representatives was prepared and distributed.
3.1.5	Select candidate test sites	Completed 11/5/72	The Northern New Jersey Shore will be the primary test site with secondary test sites to be studied as NJDEP interest, or environmental problems arise.
3.1.6	Collect and organize existing ground truth data	Completed 12/1/72	A bibliography has been prepared. Collection of pertinent ground truth will continue throughout experiment. These data will be delivered to NJDEP.

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 = Completed Tasks

TASK	HEADING	STATUS	COMMENTS
PHASE I			
3.1.7	Perform reconnaissance of test area	Completed 2/15/73	EarthSat field-checked the northern New Jersey test site in February, 1973. In addition, a reconnaissance of the entire test area was made subsequent to studies conducted at the northern New Jersey test site. EarthSat suggests a modification to this task. In the future, a phone call will be made directly to the DEP advising them of EarthSat's intention to conduct field checking. This will be followed by a brief written communication to document the timing and content of the field exercise.
3.1.8	Develop final interview plan and conduct interviews	Completed 12/10/72	Interviews with key personnel in early December have led to initial plans for information products. Subsequent briefings after initial products are prepared will be needed. EarthSat will work closely with NJDEP in using the products.
3.1.9	Prepare ground truth collection plan	Completed 3/1/73	A multi-agency cooperative ground truth effort was planned for the period April 6-13, 1973.
3.1.10	Instrument test sites	Completed 4/7/73	Instrumentation (current meters, transmissometer, spectrarradiometers, temperature recorders, PRT-5, tide gauge, etc.) was initiated in late March 1973 and was completed for the Northern Test area on April 7, 1973.
3.1.11	Prepare aerial survey plan	Completed 4/7/73	Five aircraft collected supplementary data over test site during ground survey effort on April 7, 1973; the NASA JSC C-130, NASA

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TASK	HEADING	STATUS	COMMENTS
PHASE I			
			Wallops C-54, University of Michigan C-47, and two helicopters.
3.1.12	Collect ground truth data	Completed 4/7/73	Preliminary field sampling was accomplished during reconnaissance survey and extensive sampling was completed during the April 7, 1973 effort.
3.1.13	NJDEP shall assemble equipments specified in 3.1.9 at (Toms River Facility)	Completed 4/7/73	NJDEP personnel and equipments were made available and used during April 7, 1973 ground survey effort. Personnel and equipments were coordinated from Monmouth Beach Marine Police Station.
3.1.14	Prepare line base maps for test area using simulated ERTS imagery	Completed 5/1/73	The production of line maps as designated in contract are unnecessary because all of the specified information is available on the USGS 7-1/2 minute quadrangle sheets and NOS and Naval Oceanographic Office nautical charts.
3.1.15	Use simulated ERTS imagery for candidate base maps	Completed 6/30/73	A folio of candidate ERTS-1 products has been assembled. The folio includes analytical maps for shore protection planning, ocean outfall placement, and effects of barge-dumped waste disposal. NOTE: ERTS imagery was available and there was no need to simulate it.
3.1.16	Develop and conduct Preliminary Cost-Benefits Analysis	Completed 6/15/73	The method's package for assessing and documenting benefits has been established. Two alternative methods for quantifying benefits were discussed with NJDEP (histori-

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**TASK STATUS REPORT**  
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 = Completed Tasks

TASK	HEADING	STATUS	COMMENTS
PHASE I			
			cal and future savings) and a decision to proceed on projection of future savings has been accepted. The quantification of benefits will be directed to four candidate areas: shore protection, ocean outfalls, navigation channels, and waste disposal.
3.1.17	Brief NJDEP on use of candidate information products	Completed 7/13/73	Following the approval of the Principal Investigator, DEP personnel were briefed on the utilization of ERTS information products as well as methods for assessing benefits. This briefing took place during the week of July 9-13, 1973. It is anticipated that a close interaction between EarthSat and DEP personnel will occur throughout the remainder of the program so as to facilitate full product utilization to various Department offices.
3.1.18	Establish letter contacts with other States	Pending	A draft letter has been prepared detailing the benefits derived by the State from the use of ERTS-1 and complementary aircraft data for problems related to the management, protection, & regulation of the coastal zone. This letter will be finalized and sent to all coastal states during the next reporting period.
3.1.19	Prepare plan for analysis of ERTS imagery	Completed 12/1/72	Due to compression of Phase I, initial analysis plan for ERTS Imagery was established during initial briefings with NJDEP.

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**TASK STATUS REPORT**

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TASK	HEADING	STATUS	COMMENTS
<b>PHASE II</b>			
3.2.1	First-look analysis of first imagery	Completed 9/29/72	First-look analysis documented in first NASA progress report.
3.2.2	Analyze all ERTS imagery during Phase II	Completed 4/30/73	EarthSat has analyzed all ERTS-1 imagery as received and is in the process of developing information products. Tasks 3.1.15 and 3.2.2 are essentially the same because of the early receipt of ERTS-1 imagery. As a matter of routine, all scientific observations related to coastal processes made during ERTS-1 imagery analysis are documented on EarthSat forms which constitute permanent project records (Appendix A ).
3.2.3	Analyze all ERTS imagery during Phase II by spectral band	Completed 4/30/73	All ERTS imagery is routinely analyzed by spectral band. These analyses have been referenced in previous progress reports and are part of a continuing program of image analysis. The usefulness of each spectral band (for seasons to date) has been determined and will be summarized in the First-Look Data Analysis Report. Judgements as to the usefulness of each spectral band were documented for NJDEP in October, 1972 at the initial briefing session.
3.2.4	Map coastal land-forms and outline the wetlands	Completed 3/1/73	Maps showing the outline of New Jersey wetlands as well as principal coastal ecozones (as judged from ERTS imagery) have been prepared and were delivered to NJDEP in July, 1973.

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 = Completed Tasks

TASK	HEADING	STATUS	COMMENTS
PHASE II			
3.2.5	Use optical analysis equipment, and enhancement techniques in analysis of ERTS imagery	Completed 10/31/73	This is a continuing Task and will be underway throughout the experiment. Equipment includes, I2S Digicol, I2S Addcol, Bausch & Lomb ZTS, MacBeth Densitometer, etc.
3.2.6	Review and finalize information distribution with NJDEP	Completed 7/9/73	A flow diagram has been prepared and delivered to NJDEP as a convenient visual reference to describe the ERTS information products distribution system. The relationship of each product to study objectives and a schedule for distribution of information products within the Department is presented. It is anticipated that the distribution system will be continually updated as new Department needs and products evolve.
3.2.7	Distribution of information products within NJDEP according to approved schedule.	Completed 7/13/73	Information products shall be distributed through the Principal Investigator, who will ensure that the necessary responses from Department personnel are obtained. EarthSat shall keep the Department informed of any difficulties in acquiring supporting data and of the results of product evaluation by NJDEP personnel. As specified in Task 3.1.8, close interaction between Department and EarthSat personnel is anticipated as a continuing function for the duration of the experiment.
3.2.8	Prepare preliminary data analysis report at completion of Phase II	Completed 4/20/73	EarthSat has prepared a preliminary data analysis report which details analytical results through May 15, 1973 summarizes the utility of each ERTS band for coastal

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TASK STATUS REPORT

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 = Completed Tasks

TASK	HEADING	STATUS	COMMENTS
PHASE II			
			studies, and includes copies of specific experimental analyses which have been conducted. Some results have already been reported in a paper presented at the NASA Goddard Symposium on Significant ERTS-1 Results.
3.2.9	Prepare a revised data analysis plan for Phase III	Completed 5/1/73	The revised Data Analysis Plan has been submitted.
3.2.10	Preliminary data analysis report and revised data analysis plan sent to NASA	Completed 6/1/73	
3.2.11	Finalize format and content of information products package for Phase III	Completed 7/13/73	Most of ERTS information products developed as a result of Department needs, respond to a one-time-only need and/or an immediate response, e.g., oil spills or pollution of coastal waterways and beaches, etc. Routine (repetitive) deliverables will include dredge spoil disposal and coastal surveillance maps prepared for NJDEP field inspectors. It is unlikely that rapid changes will occur in all of the information products delivered to NJDEP as was originally anticipated. The scale, format, or content of repetitively utilized products is subject to change.

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 = Completed Tasks

TASK	HEADING	STATUS	COMMENTS
PHASE III			
3.3.2	Modify data analysis procedures	Underway	This could be a continuing task throughout the experiment as new areas of analysis are uncovered and delivery schedules are modified.
3.3.3	Distribute final information products on a routine basis	Underway	All ERTS data, collateral aircraft data, and ground truth data received during the investigation will be analyzed to the extent necessary to prepare practical information products. Additional field observations will be required in the conduct of this task.
3.3.4	Work closely with NJDEP to best apply and distribute information products and document benefits derived thereof	Underway	The requirements of this task are basic to the investigation and are being met by EarthSat as the program proceeds. New activities and analyses (with unexpected benefits) are being addressed as funds permit.
4.3	Prepare final report	Underway	Sections of the final report are being written as the experiment progresses.
4.4	Prepare a program for continuing ERTS applications within New Jersey	Underway	Three new areas of interest have been identified for development into quasi-operational status; further outfall analysis, automated change detection, and waterfowl forage crop prediction.
4.5	Prepare coastal states briefing package	Underway	A brochure for coastal states is presently being prepared detailing the work performed under this investigation.